18. Find the relation between the angular momentum vector, the inertia tensor and the angular velocity vector.

19. Discuss in detail about Brownian motion by Langevin theory.

20. Explain Bose-Einstein condensation of gases

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NOVEMBER/DECEMBER 2025

GPH12/DPH12 — CLASSICAL AND STATISTICAL MECHANICS

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Formulate Lagrangian for linear harmonic oscillator.

2. State the condition for which a transformation to be canonical.

3. What are action-angle variables?

4. Write a note on theory of small oscillation.

5. Define a term symmetrical top.

6. What do you understand by nutation?

7. Define phase space.

8. State Liouville theorem.

9. What do you understand by Degeneracy?

10. Write a short note on thermionic emission.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Prove that Poisson brackets are invariant under canonical transformations.

Or

(b) State and prove Alembert's principles.

12. (a) Solve the problem of 1-D harmonic oscillator using action-angle variables.

Or

(b) Using Hamilton - Jacobi equation, solve Linear harmonic oscillator problem.

13. (a) Explain Euler angles and hence derive Euler's equation of motion.

Or

(b) Prove that if there are no forces acting on a rigid body with one point fixed, then the total kinetic energy of rotation is constant. Hence prove that $\omega L = 2T$ = constant.

14. (a) What is Gibb's paradox? How it has been resolved?

Or

(b) Define ensemble? Differentiate canonical, micro canonical and grand canonical ensembles with a suitable example.

15. (a) Explain Pauli's theory of para magnetism.

Or

(b) Derive Planck's law of radiation and explain its limitations.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Discuss various types of canonical transformations and their generating functions

17. Explain

(a) Linear triatomic molecule

(b) Forced harmonic oscillator.